Missouri Targets
Energy Solutions



MISSOURI
Department of Economic Development

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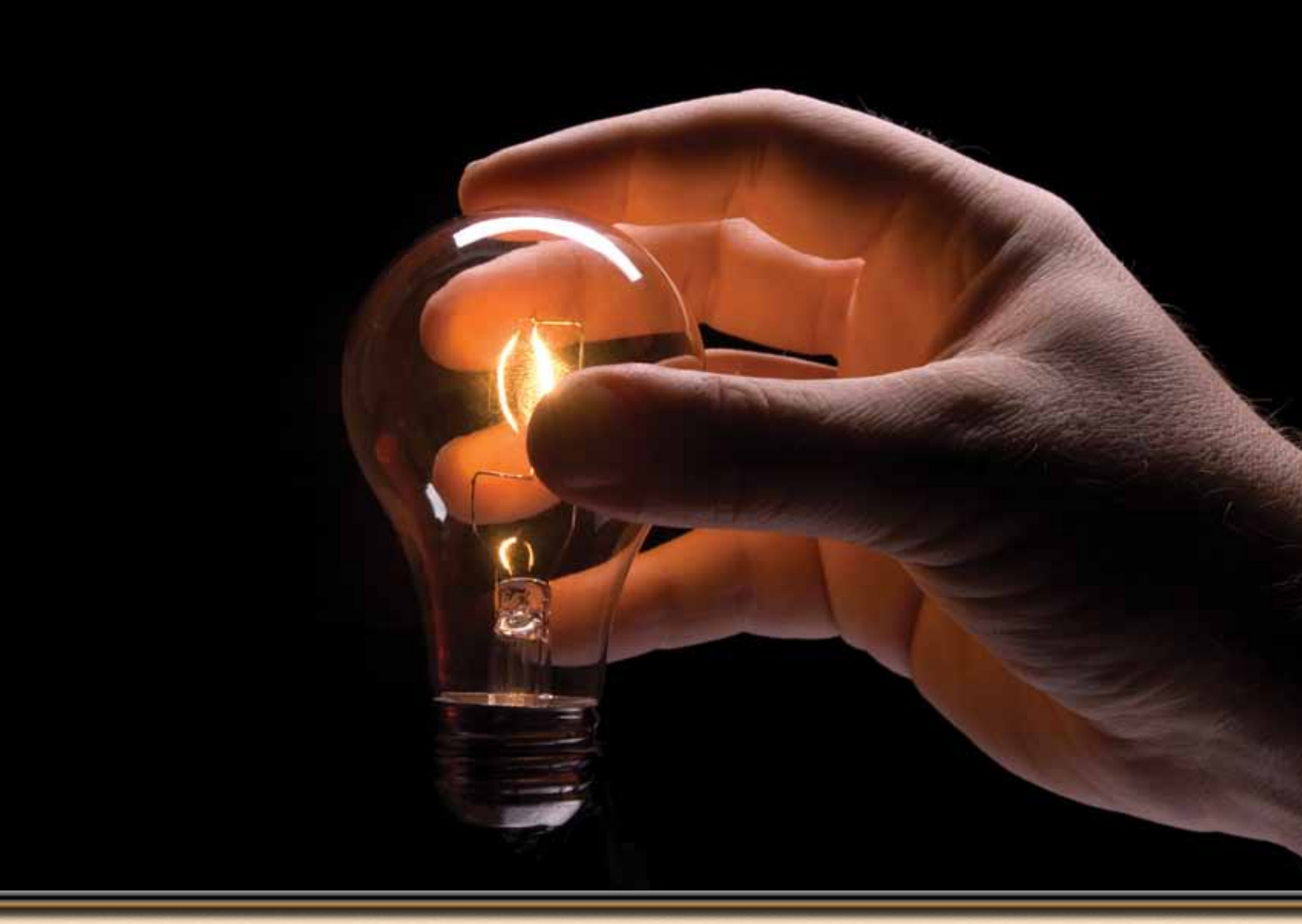
April 2012



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Energy Solutions

INTRODUCTION

The Missouri Department of Economic Development adopted the 2011 Strategic Initiative for Economic Growth to identify innovative industries with high growth potential as a frame for targeted economic and workforce efforts. Seven broad industry clusters were identified as having a higher than normal potential for employment and economic growth: Advanced Manufacturing, Biosciences, Energy Solutions, Health Sciences and Services, Information Technology, Financial and Professional Services, and Transportation and Logistics.

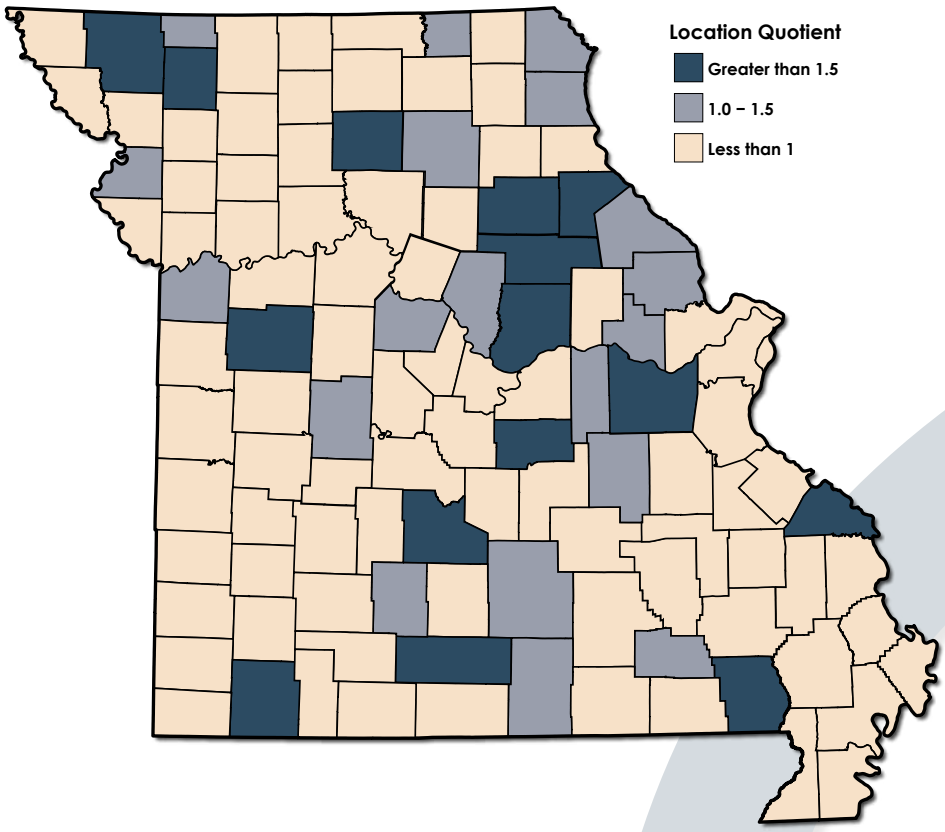
The Missouri Energy Solutions cluster targets industries focused on meeting energy demands of today and tomorrow with long-term, low-impact, and high-value innovation. It includes aggressive research, commercialization and technological advancements by Missouri industries to improve the extraction, delivery and consumption of nuclear power, natural gas, wind, solar, biomass/biofuel, and fossil fuels.

Energy Solutions is where unprecedented global demand meets decades old infrastructure, finite oil, newly tapped natural gas reserves, solar panel advancements and wind turbine innovation. Growing a robust Energy Solutions cluster means simultaneously updating an aging infrastructure, while integrating cost-effective energy efficiencies. It means increasing energy security by diversifying the sources of production in order to protect against service interruptions. It means helping global customers transition from fossil fuels to clean, renewable sources. Lastly, it means stabilizing the regulatory environment to maintain Missouri's competitive advantage of low cost utilities, low cost of doing business, and high quality of life.

Missouri has:

- 3rd lowest business energy costs (Small Business and Entrepreneurship Council)
- 5th lowest corporate income tax index (CNBC)
- 5th lowest business costs, including labor (CNBC)
- 7th best transportation system (CNBC)

County Dependence on Energy Solutions Employment



Currently the Energy Solutions cluster (see Methodology for cluster definition) employs over 53,000 workers in Missouri's private sector. An additional 19,000 worked in Missouri's utilities industries in 2011.

The county map above uses location quotient analysis (see Methodology) to illustrate areas of the state where Energy Solutions jobs account for a larger share of employment than the national averages.

Preparing Missouri's Energy Solutions Workforce

St. Louis Community College, in partnership with United Auto Workers – Labor Employment Training Corporation, hosts four accelerated training programs designed to retool workers for Energy Solutions Technician jobs.

Crowder College, in Neosho, offers a Pre-Engineering Associate of Applied Science degree, Associate of Arts degrees with biofuels, solar and wind specialization options, and six Alternative Energy Certificate tracks.

Mineral Area College, in Park Hills, offers both a Renewable Energy Technology certificate and an Associate of Applied Science degree.

Missouri University of Science and Technology in Rolla is home to the Energy Research and Development Center.

Washington University in St. Louis has the country's only department of Energy, Environmental and Chemical Engineering.

The University of Missouri Center for Sustainable Energy is a collaboration formed to focus on energy policy and management, and to coordinate research, education and commercialization of renewable energy sources.

All across the state there are examples of how Missourians are leading the way to diversify energy production and maximize efficiency. Missouri's private sector Energy Solutions activity includes farms specializing in two key biofuel crops: soybean and corn. As of 2009, Missouri ranked 9th nationally in the production of energy from biofuels. **Ford Motor Company's** Claycomo plant products will soon include the Ford Transit, a vehicle that **Smith Electric Vehicles** converts to an all-electric vehicle. Missouri's Public sector investments in Energy Solutions include *St. Joseph's* recently announced plan to convert methane gas, escaping from its landfill into enough electricity to power 1,000 homes annually. *Fulton's* landfill gas conversion generates enough electricity for two municipal buildings. *Rock Port* capitalized on its proximity to the North American wind corridor by becoming the first municipality in the country to be powered entirely by wind-generated electricity. Its electricity is supplied by the 2nd of Missouri's six operating wind farms, which collectively generate 457MW of electricity. There is another 2,050MW of Missouri wind projects in the queue. The **Missouri Alternative and Renewable Energy Technology Center at Crowder College** is lending thirty-plus years of solar technology leadership to Joplin's post-tornado rebuilding effort.

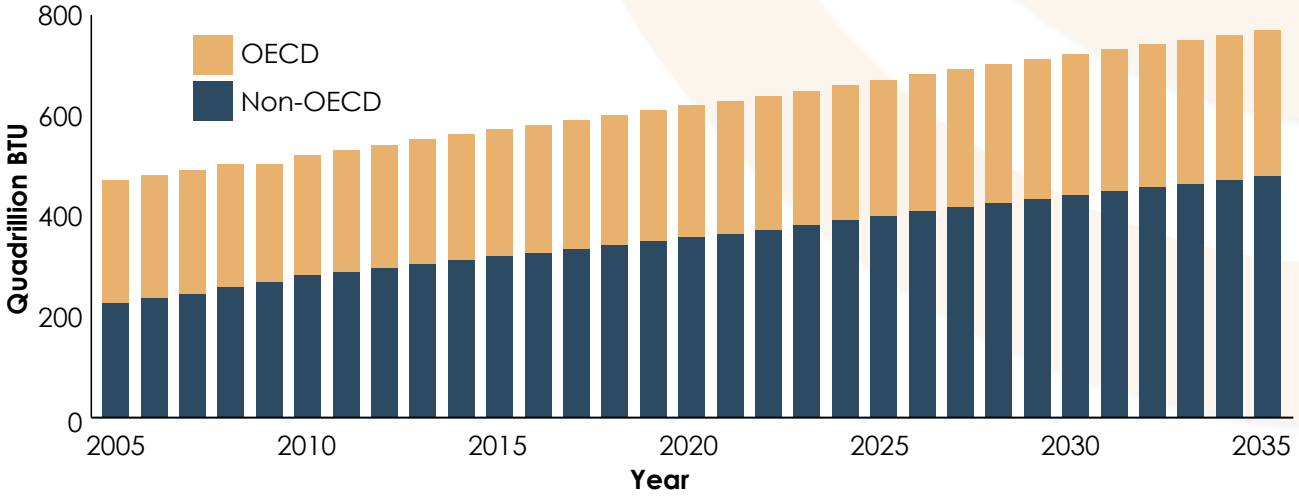
Missouri is making strides to diversify energy sources and apply new technologies to help meet unprecedented demand. Despite high fossil fuel consumption, Missouri ranks 3rd, among neighboring states, in the efficiency of energy it produces from all sources. Energy Solutions in Missouri has seen employment growth in fields including *Management, Scientific, and Technical Consulting Services* and *Scientific Research and Development*. For the past forty years Missouri's inventors averaged almost 500 Energy Solutions-related Utility patents per decade. Growing activity in key Energy Solutions manufacturing feeds an export total in excess of $4 billion. These strides give Missouri a competitive advantage in meeting local and global demands for Energy Solutions.

GLOBAL ENERGY DEMANDS

Global trends suggest a growing demand for energy. According to the U.S. Energy Information Administration (EIA), global energy consumption grows 53 percent (assuming no interventions) between 2008 and 2035, with much of the growth occurring in countries outside the Organization for Economic Cooperation and Development (non-OECD).

World Total Energy Consumption by Region

(reference case)



Source: U.S. Energy Information Administration

Fossil fuels will remain the largest source of energy for many decades. Despite new discoveries of natural gas resources, fossil fuel supplies are ultimately finite. Increasing global demand for energy will drive fossil fuel prices higher and increase demand for renewable energy solutions. The EIA forecasts renewable energy will be the fastest growing form of energy between 2008 and 2035. This growth presents an opportunity for Missouri to share its Energy Solutions knowledge and innovation globally.

Meeting Missouri's Energy Demands

Missouri consumed 1,817 trillion British Thermal Units (BTUs) of energy in 2009. Ninety-four percent of all electrical and transportation energy consumed in Missouri, in 2009, came from coal, petroleum or natural gas. Nearly all the fossil fuel consumed in Missouri is imported.

The Missouri Clean Energy Initiative, passed in 2009, supports the transition from fossil fuels to renewable sources by requiring the three investor-owned utilities, Ameren Corporation, The Empire District Electric Company, and Kansas City Power & Light, to meet 15 percent of their power with clean energy by 2021.

Missouri Innovation Campus

The commercialization of renewable energy relies on the decentralization of the current energy production and distribution grid. **Exergonix Incorporated**, of Lee's Summit Missouri, is a start-up merging energy management, battery technology, and renewable energy expertise together to develop utility-size energy storage units.

In February 2012 Exergonix announced a partnership with University of Central Missouri and Summit Technology Academy to develop an Innovation Campus at the company's headquarters. Financially supported by a Missouri Community Development Block Grant, the Campus will serve as a co-operative learning environment for STEM-focused high school students.

The partnership is designed to expedite student education by indentifying high school students capable of learning on the job at Exergonix. In exchange Exergonix commits to pay the student's tuition to University of Central Missouri for an Associate's degree program, and promises a job to the student upon graduation.

The flagship program can be replicated around the state by any company and higher education institution pair ready to educate and employ the next generation of STEM workers. The partnership is designed to reduce the cost of student education, increase graduate employment, decrease workforce training obligations by employers and advance the technological innovation capacity of Missouri.

ENERGY SOLUTIONS SUPPLY CHAIN

Missouri is in a unique position to supply the component parts to update an aging electrical infrastructure nationally, build the infrastructure for electricity in developing regions, and to provide the knowledge and innovation necessary to diversify energy production.

Missouri is home to a complex supply chain for Energy Solutions. The chain begins with raw materials like coal mined and transported by companies like St. Louis-based **Peabody Energy**. The chain includes home grown businesses like **Meramec Electrical Products**, headquartered in Cuba Missouri since 1969, who manufactures component parts for electrical transformers, for sale to clients like ABB of Jefferson City. **ABB** built the transformers for wind turbines built by General Electric. **Wind Capital Group**, of St. Louis, used GE turbines for the 100-unit Lost Creek Ridge Wind Farm in DeKalb County Missouri. The 2005 start-up developed and operates five Missouri wind farms.

Architecture, engineering, environmental and construction firms from Missouri including **Burns & McDonnell** and **Black & Veatch Corporation**, both of Kansas City, and **Branco Enterprises Inc**, Neosho, are hired to manage projects all over the world. Fast growing companies like **ProEnergy Services** of Sedalia and **MEMC** of St. Peters export Energy Solutions products and services all over the world. North American Energy Solutions supply chain management is facilitated by St. Louis-based **Graybar** who specializes in the distribution of electrical components. Missouri companies like **EaglePicher Technologies LLC**, Joplin, and **Exergonix Inc.**, Lee's Summit, both of whom are advancing the field of energy storage, are developing the crucial technology necessary to meet future energy demands.

Missouri's Energy Solutions target is attracting national and international attention. **Nordic WindPower USA, Inc.** cited Missouri's quality of life, workforce and transportation infrastructure as contributing factors in its 2010 decision to consolidate its west coast headquarters, R&D and wind turbine manufacturing facilities all in Kansas City. **Vest-Fiber ApS**, of Denmark, chose Moberly for its expanding fiberglass products manufacturing operation. The 2010 announcement to produce component parts for wind turbines demonstrates Missouri's attractiveness to businesses.

ABB employs 475 cross-trained United Auto Workers employees in the production of electrical transformers for use in wind turbines. The partnership demonstrates the potential to retool Missouri's highly-skilled manufacturing workforce for the production needs of the Energy Solutions cluster.

INNOVATION

Patent Technology

Missouri's Energy Solutions innovation is led by four decades of individual entrepreneurs. According to the U.S. Patent and Trademark Office, Missouri individual owner assignees received patents for nearly all the major Energy Solutions-related patent classes.

Since 1965 Missouri Assignees patented over 600 inventions in three core Energy Solutions classes: *Electrical Generator or Motor Structure, Illumination,* and *Electrical Connectors*. In the last decade, Missouri saw a 41 percent growth in core Energy Solutions patent awards compared to two decades ago. **Emerson Electric**, headquartered in St. Louis since 1890, is the most prolific Energy Solutions Assignee in Missouri. Between 2006 and 2010, Emerson Electric earned 133 patents, including for innovations in E*lectrical Generator or Motor Structure, Motive Power Systems,* and *Electrical Systems and Devices*. New to Missouri's Energy Solutions R&D is **Phycal LLC**, an Ohio-based firm, who brought its algae biotechnology laboratory to the **Donald Danforth Plant Science Center** in St. Louis. With the assistance of a $24.2 million federal research grant, the Phycal team is developing and commercializing biodiesel from algae oil and methane gas.

Top Energy Solutions-Related Patent Assignees with Operations in Missouri

Headquarters

Emerson Electric Co.

Mallinckrodt Inc.

Hussmann Corporation

Watlow Electric Manufacturing Co.

Sherwood Services AG

Operations

Boeing Company

Sprint Communications Company

General Electric Company

E.I. Du Pont De Nemours and Co

American Power Conversion Corporation

Cooper Technologies Co

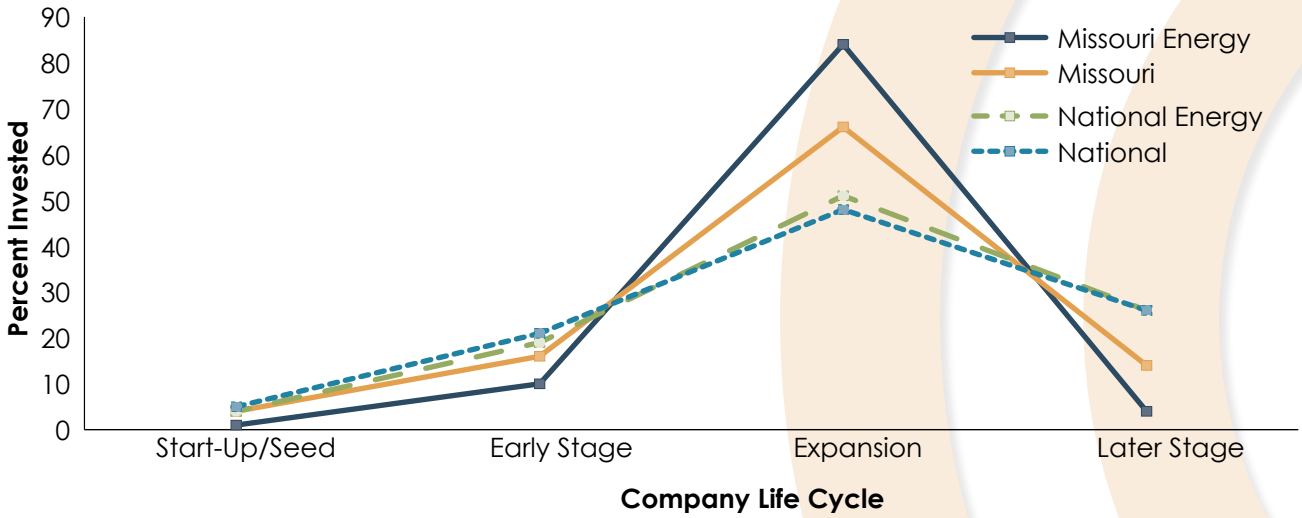
Federal-Mogul World Wide Inc.

Financing

Developing a robust Energy Solutions cluster means making capital-intensive investments in hardware and infrastructure, while also growing the customer base. Funding innovation to support a clean economy requires capital sources with a tolerance for risk not often seen in the traditional private capital sources.

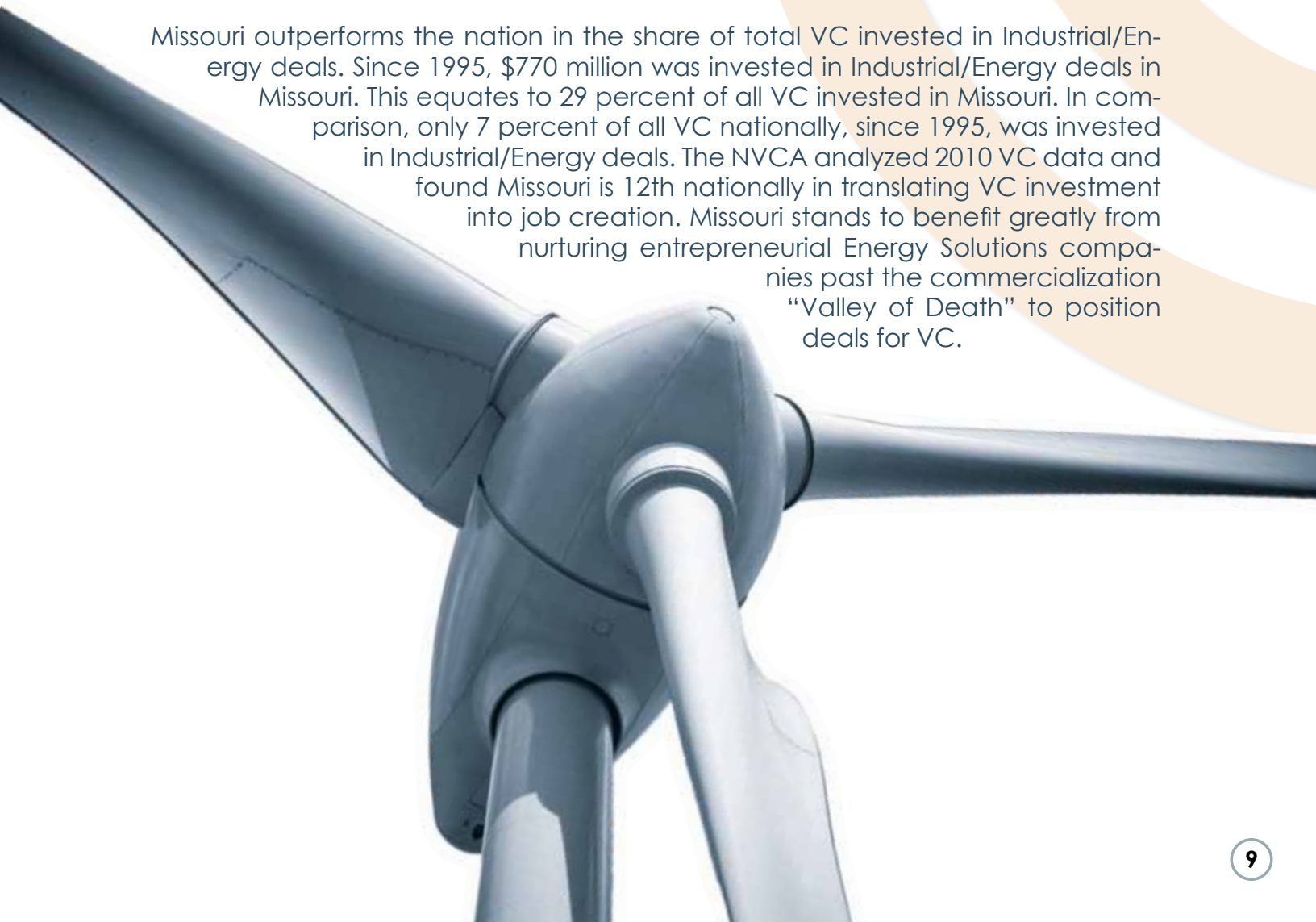
The national trend for venture capital (VC) investment demonstrates an aversion to early-stage risk. According to PricewaterhouseCoopers and the National Venture Capital Association (NVCA), almost half of all venture capital went to expansion stage deals. *Start-up/Seed* and *Early Stage* deals combined received roughly a quarter of total invested dollars. Missouri VC demonstrates an even stronger risk aversion. Since 1995, 66 percent of VC investment went to *Expansion Stage* deals. That number jumps to 84 percent when looking at Industrial/Energy deals. Entrepreneurial producers and suppliers of energy, chemicals, and materials, or companies involved in industrial automation, oil and gas exploration, environmental, agricultural, transportation, manufacturing, construction or providing utility-related products and services have a difficult time securing financing from the risk-adverse Venture Capital network until they mature to the expansion stage.

Venture Capital Investment by Stage



Source: PricewaterhouseCoopers and the National Venture Capital Association, Data from Thomson Reuters

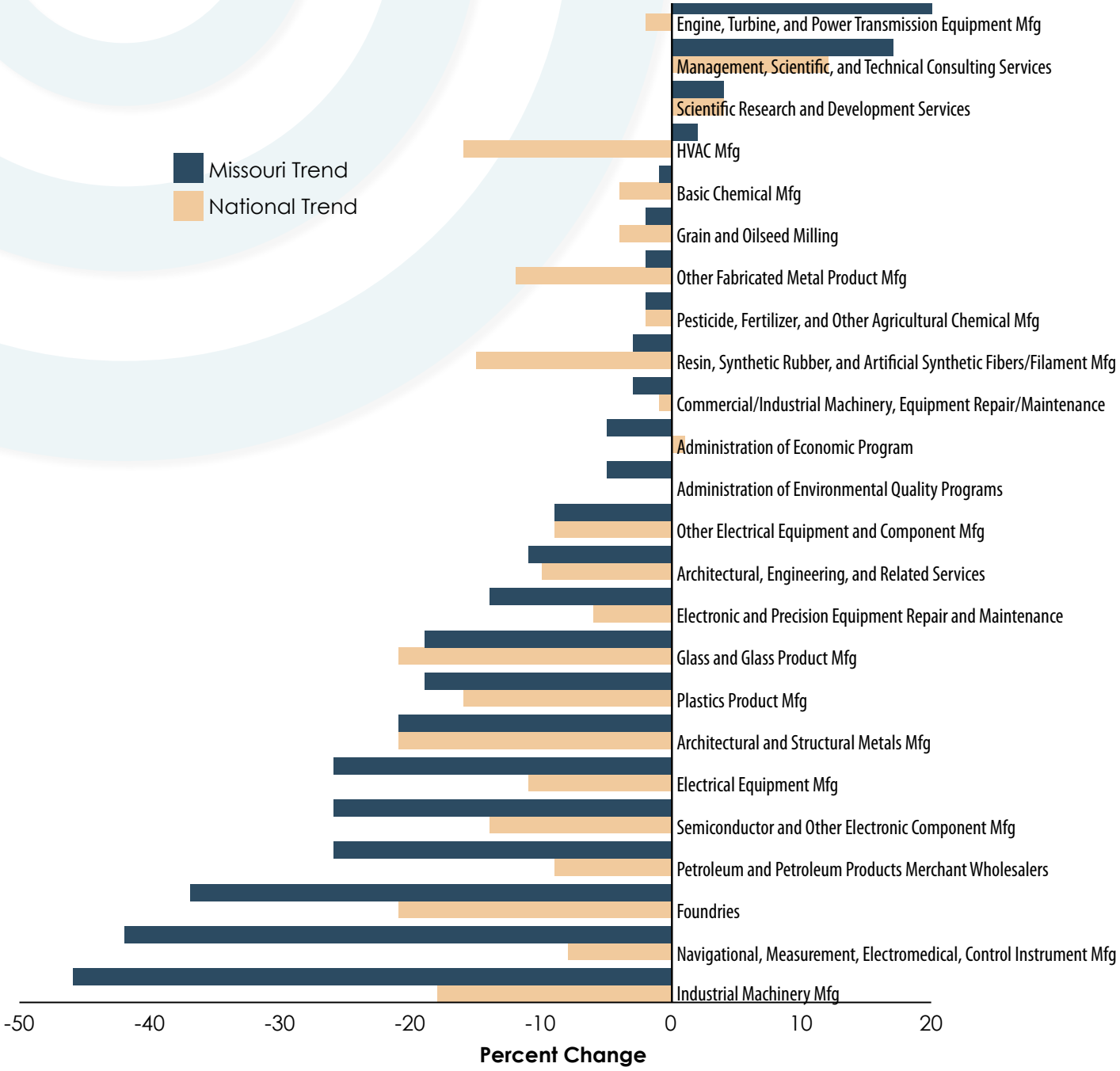
Missouri outperforms the nation in the share of total VC invested in Industrial/Energy deals. Since 1995, $770 million was invested in Industrial/Energy deals in Missouri. This equates to 29 percent of all VC invested in Missouri. In comparison, only 7 percent of all VC nationally, since 1995, was invested in Industrial/Energy deals. The NVCA analyzed 2010 VC data and found Missouri is 12th nationally in translating VC investment into job creation. Missouri stands to benefit greatly from nurturing entrepreneurial Energy Solutions companies past the commercialization "Valley of Death" to position deals for VC.



EMPLOYMENT

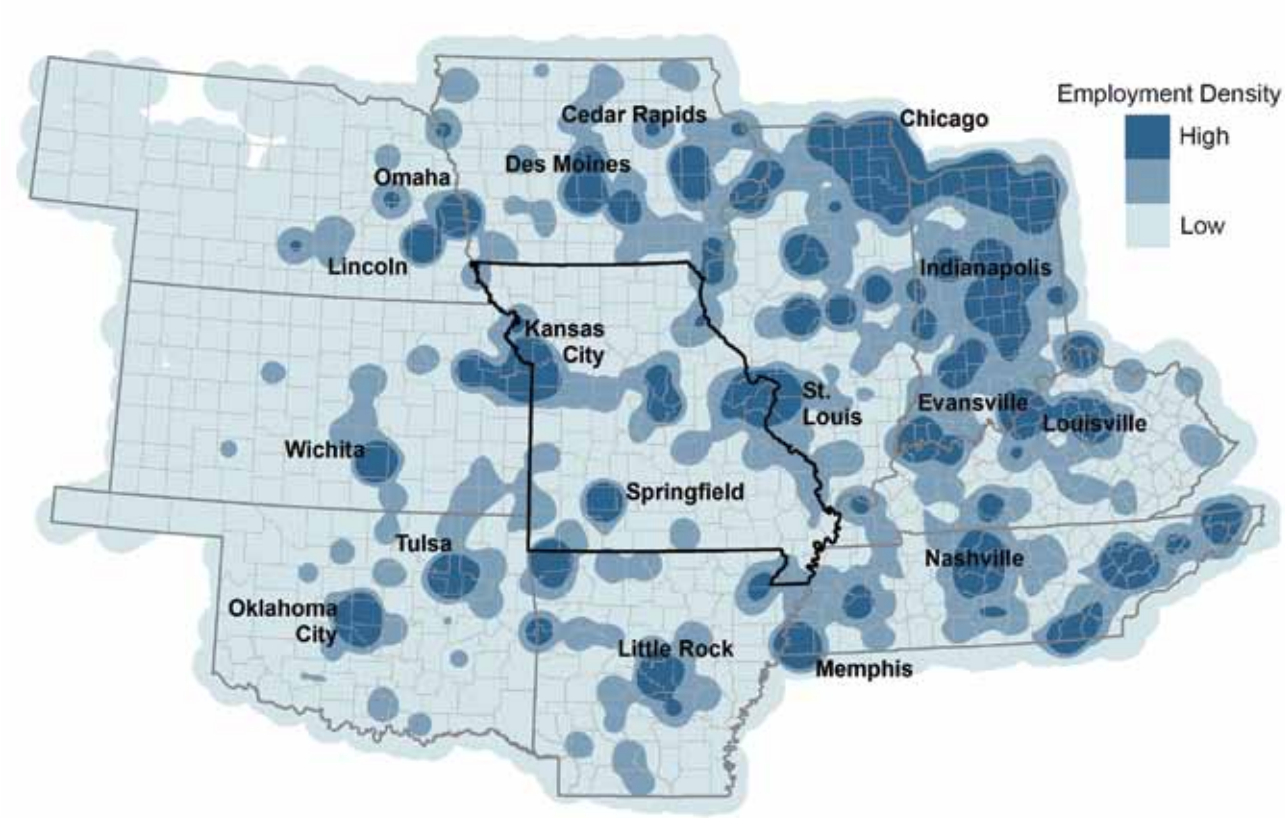
The Energy Solutions cluster includes activity in manufacturing, wholesale trade, professional, technical and other services, and public administration. In the last five years, Missouri's non-farm employment in the cluster declined by 9 percent, more than the national decline of 6 percent but better than the Midwest decline of 10 percent. Employment growth in *Management, Scientific, and Technical Consulting Services* (17%), and *Scientific Research and Development Services* (4%) mirrors the national trend. Missouri outperforms the nation in *Engine, Turbine, and Power Transmission Equipment Manufacturing* (20%), and *HVAC Manufacturing* (2%).

Energy Solutions Trends 2007–2011



Within the Midwest, Missouri ranks third behind Illinois and Tennessee in Energy Solutions employment. In 2011, Missouri hosted 16 percent of the cluster's total non-farm employment in the nine-state area. The Midwest Energy Solutions cluster had negative employment growth of 10 percent between 2007 and 2011. Missouri, with 9%, ranked fourth behind Iowa (19%), Illinois (10%), and Kentucky (10%) for percent decline in employment.

Regional Employment Density for Energy Solutions



WORKFORCE

Missouri's Energy Solutions occupations primarily include Production Line positions (38%), Engineering and Architectural Services (21%), and Office Administration and Support Services (9%). Energy Solutions occupational groups projecting growth over the next decade include Business and Financial Operations (27%), IT Services (24%), Science Occupations (19%) and Engineering and Architectural Services (10%). Annual wages for the prospective growth occupations are estimated to average over $59,000.

The Energy Solutions occupations of Civil Engineers, Computer Controlled Machine Tool Operators, and Computer Specialists are expected to experience the most growth over the next decade. Team Assemblers, Civil Engineers, and Electronic Equipment Assemblers are expected to hold the largest number of jobs in this cluster over the next decade.

Top Energy Solutions Occupations by Projected Growth 2008–2018

Energy Solutions Occupations	Typical Education	Average Wage
Engineering and Sciences		
Civil Engineers	Bachelor's degree	$75,812
Industrial Engineers	Bachelor's degree	$71,352
Environmental Engineers	Bachelor's degree	$71,924
Biochemists and Biophysicists	Doctoral degree	$63,276
Biological Technicians	Bachelor's degree	$36,503
Engineers, All Other	Bachelor's degree	$83,481
Surveying and Mapping Technicians	Moderate-term on-the-job training	$35,921
Production		
Computer-Controlled Machine Tool Operators, Metal and Plastic	Moderate-term on-the-job training	$30,455
Industrial Machinery Mechanics	Long-term on-the-job training	$43,547
Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	Moderate-term on-the-job training	$29,527
IT Services		
Computer Specialists, All Other	Associate degree	$74,506
Network Systems and Data Communications Analysts	Bachelor's degree	$74,788
Computer Software Engineers, Systems Software	Bachelor's degree	$78,384
Computer Software Engineers, Applications	Bachelor's degree	$76,059
Business and Administrative Services		
Compliance Officers	Long-term on-the-job training	$50,250
Business Operations Specialists, All Other	Bachelor's degree	$60,872
Construction and Building Inspectors	Work experience in a related occupation	$45,052
Executive Secretaries and Administrative Assistants	Work experience in a related occupation	$41,896
Accountants and Auditors	Bachelor's degree	$58,199
Purchasing Agents, Except Wholesale, Retail, and Farm Products	Long-term on-the-job training	$52,686

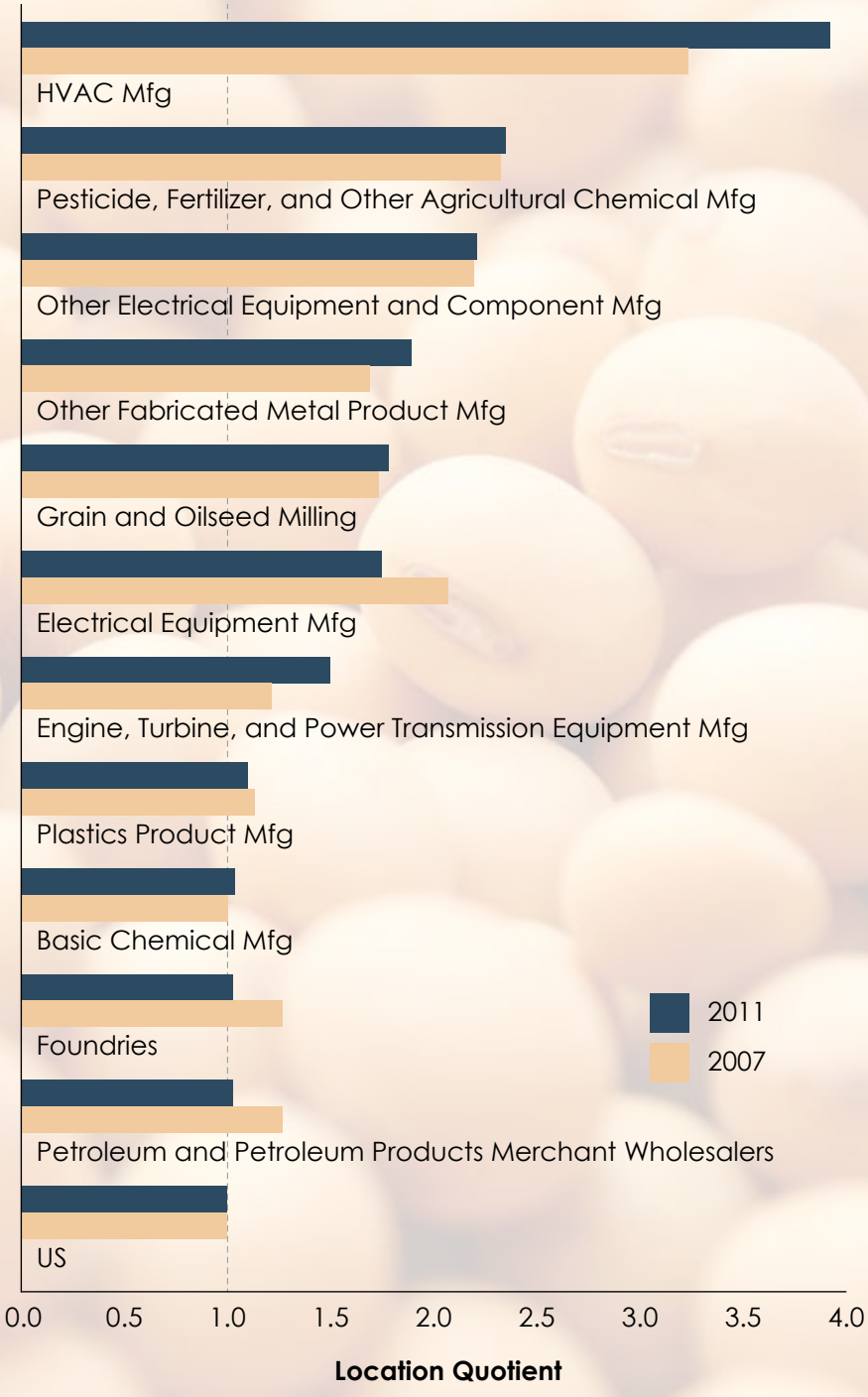
Analysis of education and experience levels typically required by all occupations in the Energy Solutions cluster shows that 15.4 percent are considered lower skilled, 52.2 percent are middle skilled, and 32.4 percent are high skilled. Energy Solutions skill requirements are more heavily weighted towards middle to high skill occupations with 84.6 percent of the jobs in this cluster requiring middle to high skills compared to 63.6 percent for all occupations in Missouri.

INDUSTRY CONCENTRATION

Energy Solutions employment levels are highest in specific manufacturing activity. *HVAC Manufacturing* had the highest employment concentration in Missouri for Energy Solutions industries when compared to the national industry mix.

In total 11 of Missouri's Energy Solutions industries hosted a greater share of 2011 employment than the national averages. Seven of the top 11 also increased their concentration between 2007 and 2011. For example, the location quotient (see methodology) for *HVAC Manufacturing* increased from 3.23 to 3.92. *Engine, Turbine, and Power Transmission Equipment Manufacturing* increased from 1.21 to 1.50. *Other Fabricated Metal Product Manufacturing* increased employment concentration from 1.69 to 1.90 between 2007 and 2011.

Missouri Energy Solutions Industry Concentration



MISSOURI'S ENERGY SOLUTIONS EXPORTS

Missouri's 2011 Energy Solutions cluster exports exceeded $4 billion. The Energy Solutions' export value makes up 29 percent of the total Missouri commodity base and experienced strong growth (25.6%) between 2007 and 2011. With a location quotient of 1.14, Energy Solutions exports represent a slightly greater share of Missouri's total exports compared to the national mix.

The state's biggest exporting industries in the Energy Solutions cluster include *Basic Chemicals, Grain and Oilseed Milling Products*, and *Electrical Equipment and Components*. Compared to national averages, the state also has very high export concentrations in the areas of *HVAC Equipment* (LQ=3.80), *Grain and Oilseed Milling Products* (2.95), *Pesticides, Fertilizers and Other Agricultural Chemicals* (2.42), and *Architectural and Structural Materials* (2.15).

While Missouri trailed the nation in single year Energy Solutions export growth, several commodity sectors are above the national trend including *Other Fabricated Metal Products, Electrical Equipment,* and *Pesticides, Fertilizers and Other Agricultural Chemicals*. The table below highlights the over-the-year trends in Energy Solutions commodities.

Missouri Energy Solutions Exports

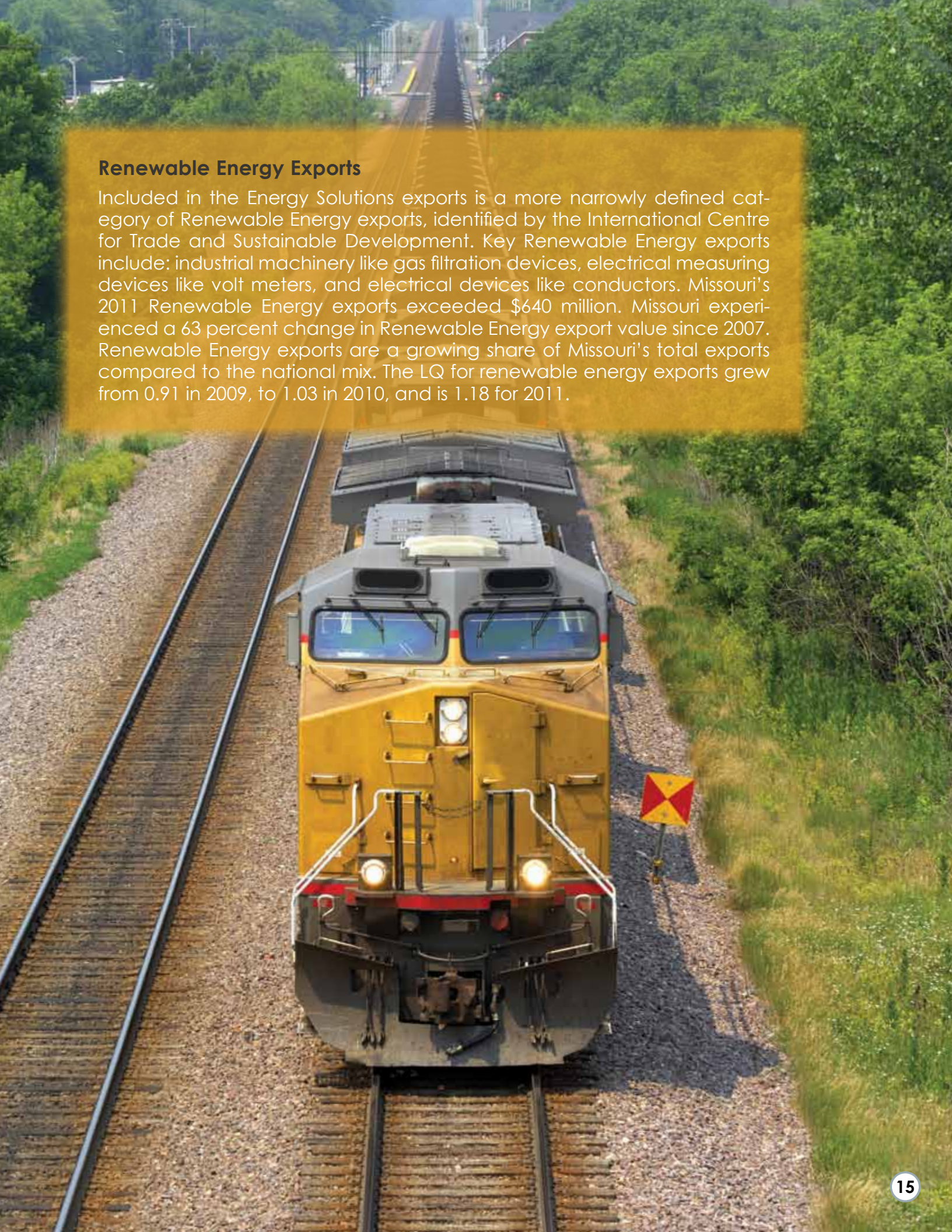
Industry	Annual Exports 2011	Percent Change Missouri 2009–2010	Missouri 2010–2011	National 2010–2011	LQ 2011
TOTAL ALL INDUSTRIES		35.74	9.44	15.83	
TOTAL ALL ENERGY SOLUTION INDUSTRIES	$4,150,581,875	42.94	-4.29	8.42	1.14
High Growth (5 yr trend) / High Concentration					
Grain and Oilseed Milling Products	$365,108,334	45.41	2.31	1.38	2.95
Other Fabricated Metal Products	$337,249,491	15.8	42.54	13.67	1.46
Pesticides, Fertilizers and Other Agricultural Chemicals	$232,890,854	84.19	16.39	24.75	2.42
Electrical Equipment	$181,913,118	25.79	18.43	13.85	1.18
Architectural and Structural Metals	$51,435,271	66.28	0.28	11.15	2.15
Lower Growth (5 yr trend) / High Concentration					
Basic Chemicals	$1,214,127,432	56.5	-12.92	17.11	1.86
Electrical Equipment and Components, NESOI*	$345,594,677	31.84	-26.59	13.48	1.96
Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment	$285,385,357	18.52	-0.22	12.43	3.80
High Growth (5 yr trend) / Low Concentration					
Navigational, Measuring, Electromedical, and Control Instruments	$291,385,553	38.84	20.04	10.01	0.64
Plastics Products	$170,196,553	31.15	5.2	9.34	0.93
Resin, Synthetic Rubber, & Artificial & Synthetic Fibers & Filament	$131,141,223	6.95	28.2	12.66	0.34
Industrial Machinery	$105,087,124	27.56	9.12	-9.22	0.67
Lower Growth (5 yr trend) / Low Concentration					
Engines, Turbines, and Power Transmission Equipment	$255,743,233	78.01	-34.83	10.51	0.95
Semiconductors and Other Electronic Components	$169,643,856	31.64	-0.78	-4.24	0.29
Glass and Glass Products	$11,171,714	40.34	-2.79	5.66	0.24
Foundries	$2,508,085	70.31	-71.79	9.62	0.24

** Not either specified or included*

Source: WISERTrade

Renewable Energy Exports

Included in the Energy Solutions exports is a more narrowly defined category of Renewable Energy exports, identified by the International Centre for Trade and Sustainable Development. Key Renewable Energy exports include: industrial machinery like gas filtration devices, electrical measuring devices like volt meters, and electrical devices like conductors. Missouri's 2011 Renewable Energy exports exceeded $640 million. Missouri experienced a 63 percent change in Renewable Energy export value since 2007. Renewable Energy exports are a growing share of Missouri's total exports compared to the national mix. The LQ for renewable energy exports grew from 0.91 in 2009, to 1.03 in 2010, and is 1.18 for 2011.



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METHODOLOGY

Energy Solutions Industry Definitions from Market Street Consultants

NAICS	Energy Solutions	NAICS	Energy Solutions
3112	Grain and Oilseed Milling	3344	Semiconductor and Other Electronic Component Mfg
3251	Basic Chemical Mfg	3345	Navigational, Measurement, Electromedical, Control Instrument Mfg
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers/Filament Mfg	3353	Electrical Equipment Mfg
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Mfg	3359	Other Electrical Equipment and Component Mfg
3261	Plastics Product Mfg	4247	Petroleum and Petroleum Products Merchant Wholesalers
3272	Glass and Glass Product Mfg	5413	Architectural, Engineering, and Related Services
3315	Foundries	5416	Management, Scientific, and Technical Consulting Services
3323	Architectural and Structural Metals Mfg	5417	Scientific Research and Development Services
3329	Other Fabricated Metal Product Mfg	8112	Electronic and Precision Equipment Repair and Maintenance
3332	Industrial Machinery Mfg	8113	Commercial/Industrial Machinery, Equipment Repair/Maintenance
3334	HVAC Mfg	9241	Administration of Environmental Quality Programs
3336	Engine, Turbine, and Power Transmission Equipment Mfg	9261	Administration of Economic Programs

Location Quotient

Location Quotient (LQ) is a statistical measure of an industry concentration. The quotient indicates the geographical concentration of an industry in an area as a function of the expected concentration based on the national average. Location Quotient was calculated using the BLS Regional Data Analysis Tool (RDAT). The LQ formula is: (Area Industry Emp./Area Total Emp.)/(U.S. Industry Emp./U.S. Total Emp.)

LQ>1 indicates an industry concentration.

LQ=1 indicates expected concentration based on U.S. Average.

LQ<1 indicates no industry concentration.

ABOUT MERIC

The Missouri Economic Research and Information Center, or MERIC, is the research division of the Missouri Department of Economic Development. We provide innovative analyses and assistance to policy makers and the public, including studies of the state's targeted industries and economic development initiatives. Our mission is to deliver value-added research with a customer focus.

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